Population Structure and Age Determination in a Series of Skulls from Four Populations of the Tasmanian Brush-tailed Possum *Trichosurus vulpecula*

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by

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ABSTRACT

Skulls of brush-tailed possums *Trichosurus vulpecula* from four areas in Tasmania were classified into age groups on the basis of molar tooth wear and a series of measurements taken from each skull. Sagittal crest length over skull length for the various wear classes appears to bear a close relationship to age and it is suggested that this could be used to give a ready scale for age determination of skulls. The pastoral areas have populations with a greater representation of both younger animals and males. Some possible explanations for these differences are suggested.

INTRODUCTION

Troughton (1965) accepts the Tasmanian and Bass Strait Island populations of the brush-tailed possum *Trichosurus vulpecula* (Kerr, 1792) as a distinct species, *Trichosurus fuliginosus* (Ogilby, 1831) and states "Because of its insular range, decidedly larger size and more strongly built skull and dentition it seems advisable to accept Gould's opinion that it represents a distinct species". "The fur also differs in being longer and richer. As a result the Tasmanian possum is much sought after by trappers and the fur trade generally." Green (1973, 1974) accepts it at subspecific level and states "Until about 1940 it was confined to the forests and mountainous areas but it has since increased and spread, so that it now occurs commonly in most habitats even entering suburban gardens".

For many years the brush-tailed possum was subjected to an open season during the winter months when animals could be shot, snared or trapped under licence for their commercially valuable skins. The "open season licence" system has recently been replaced by a system of "special permits" issued for the taking of animals by shooting only, and then only in areas where their numbers and browsing habits cause economic damage.

From 1965 to 1975 approximately 100,000 brush-tailed possums were taken each season. Since then the figure has been between 200,000 and 300,000 per annum. In 1979, 2,640 permits were issued which resulted in the shooting of about 300,000 possums (National Parks and Wildlife Service unpublished report, 1980).

MATERIALS

During the winter of 1979 the opportunity was taken by the Queen Victoria Museum, Launceston, to salvage some of the pouch young and the skulls of brush-tailed possums shot under permit. Four widely separated localities were selected (map, Figure 1) and may be briefly described as follows.

(i) "Kingston" via Nile is a pastoral property below the western slopes of Ben Lomond. The fertile valleys and arable land have long been cleared and sown to crops and permanent pasture. To the west the hilly terrain supports dry sclerophyll and savannah woodland while to the east the mountain slopes support mixed sclerophyll forest. "Kingston" is at an altitude of about 400m and has an annual rainfall of about 800mm. Brush-tailed possums were shot over most of the property, many being taken on pasture and cropland.

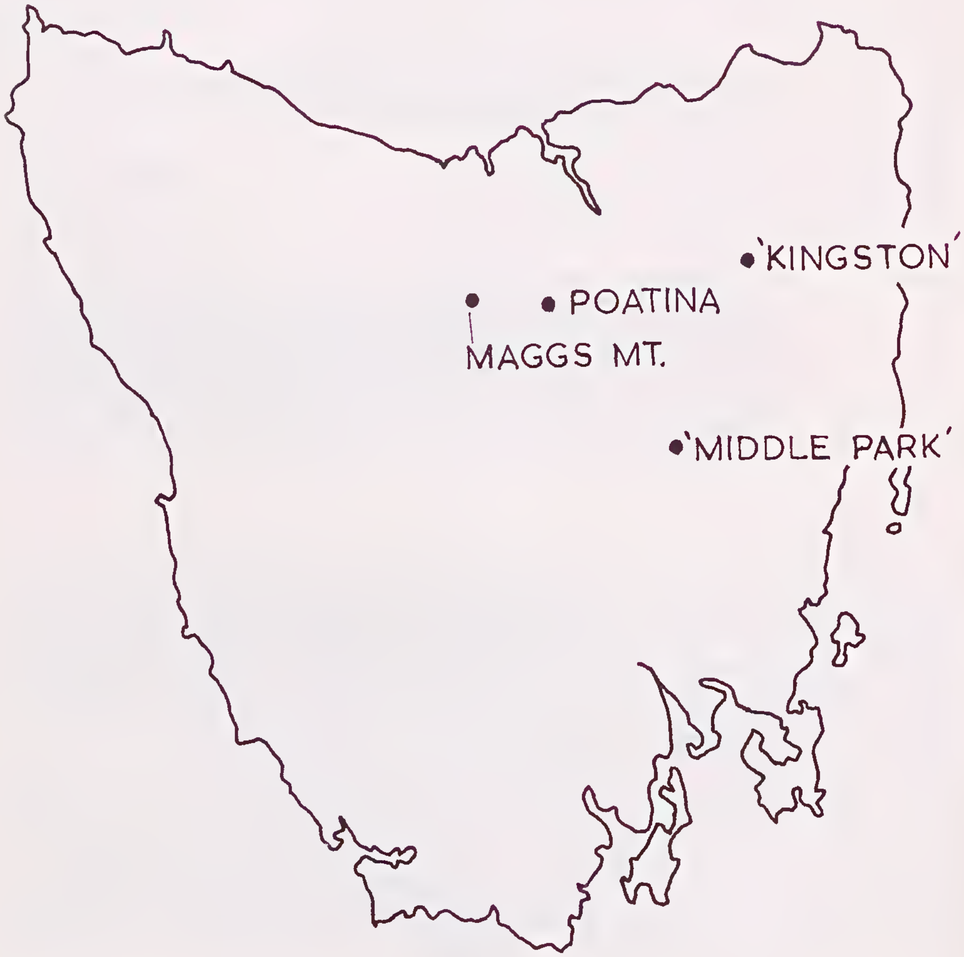

FIGURE 1

Map showing the localities from which the four samples were collected.

(ii) "Middle Park" at Antill Ponds is a pastoral property spanning the Midland Highway below the south-eastern slopes of the Great Western Tiers. Arable land in the valleys has been cleared and sown to pasture for many years and the surrounding cleared hills and open woodland have been aerial top dressed with superphosphate for the past twenty-five years. To the west the topography becomes progressively more elevated, rugged and timbered with mixed sclerophyll forest. "Middle Park" is at an altitude of about 300m and has an annual rainfall of about 550mm. Brush-tailed possums were collected from all over the property.

(iii) Poatina is a small village, established by the Hydro-electric Commission on the north-eastern slopes of the Great Western Tiers. Its north-eastern aspect overlooks the fertile, arable plains of the northern midlands while to the south and west the tiers rise steeply to the Great Lake plateau and support dense mixed forest. Poatina is at an altitude of 400m and has an annual rainfall of about 1,000mm. Brush-tailed possums were shot from wet sclerophyll forest on the slopes of the Great Western Tiers around and above Poatina.

(iv) Maggs Mountain is an elevated plateau between the Mersey Valley and the Arm Valley and has, for the past six years, been subjected to the progressive clear-felling of forest compartments for timber (Green 1977). The mountain and general area surrounding it supports mixed sclerophyll forest, rainforest, and on previously clear-felled compartments, varying stages of *Eucalyptus delegatensis* regeneration. The plateau of Maggs Mountain is at an altitude of 880m and has an annual rainfall of about 1,600mm. Brush-tailed possums were shot throughout the general area.

In each area the co-operation of a responsible permit holder was obtained to salvage material from all and only those animals shot under their respective permits. All female possums thus shot were examined and the pouch young removed and preserved in 4% formalin, a total of 408 pouch young being collected. After skinning of the adults the heads were removed, those of males (624) being threaded on one wire and those of females (520) on another. A total of 1,144 was collected.

This material was picked up and recorded by museum staff every two weeks. The date of capture was taken as mid-way between the two collection dates thus giving the date of capture to within an accuracy of plus or minus seven days.

After pick-up, heads were deep frozen until being sorted for cleaning in a colony of dermestid beetles *Dermestes* sp. As possums are generally shot in the region of the head and neck in order to avoid skin damage and devaluation of the market price, many skulls are badly shattered. Juvenile and obviously "rumpy" possums (Munday, 1978) are not usually skinned, even if shot, as the value of the skin does not warrant their skinning, although the skulls from these specimens are included in the collection. Only those heads with no, or minimal, damage to the skull were retained for cleaning and registration as cabinet specimens, those more extensively damaged being discarded after counting. This resulted in the discarding of about two-thirds of the heads, leaving 381 skulls for examination.

METHODS

Skulls from each of the four localities were separated into male and female and then divided into seven classes on the basis of tooth wear of the molar M^1, class 1 being those showing the least molar wear and Class 7 the most molar wear, thus giving an approximation of the age of the animal (Winter, 1980). The breakdown of the material into each of the classes for each locality gives an approximation of the age structure of the local populations (Table 1).

Three measurements were taken from each skull : skull length (S.L.), facial skull length (F.S.L.), and sagittal crest length (S.C.L.) (Figure 2). In very young animals, the sagittal crest did not always extend to the back of the skull, however measurements of the length of the sagittal crest were always taken from the back of the skull to the anterior end of the crest.

The mean ratios of the sagittal crest length to the skull length $\frac{SCL}{SL}$ afterwards referred to as the Sagittal Index, and the facial skull length to the skull length $\frac{FSC}{SL}$ afterwards referred to as the Facial Index, were determined for each wear class in each locality, males and females both separately and combined (Table 2). Standard deviations from the mean of the total population, males and females combined, were calculated. Mean ratios were also compared with the tooth wear class (Figures 3, 4, 5).

RESULTS AND DISCUSSION

Winter (1980) shows that wear on the molar tooth M^1 increases proportionally with age (Figure 3) and his information was collected from a sample of brush-tailed possums of known age in Queensland.

In our series, the mean Sagittal Index increases as the molar wear class, from juvenile to aged animals (Figure 3). The value of the Sagittal Index appears to bear a direct relationship to the mean age of that particular group of specimens as derived from the molar wear class for all molar wear classes (and hence age groups) in the population from juvenile to aged. There is little variation between widely separated populations (Figures 3, 4) and so the Sagittal Index is assumed to be standard for populations of the Tasmanian brush-tailed possum. Males show a slightly higher mean Sagittal Index than females. This is present in most molar wear classes and in each population sampled.

Standard deviations from the mean of the total population, males and females combined, for each molar wear class show a wide distribution about the mean of each class (Table 2). This could imply that the Sagittal Index is not a sufficiently precise value to use for age determination of individual skulls. However, there is a range of from two to four years for each molar wear class of the known-age sample and the high standard deviations are likely to be a reflection of this. It is suggested that a more reliable estimate of age for the brush-tailed possum could be obtained by standardising the Sagittal Index against a series of skulls of known age.

The Sagittal Index could be standardised using cementum deposition in teeth to determine the true age of a skull. The advantage of using the Sagittal Index to determine the age of a specimen rather than molar wear is that it is quicker, there is less observer variability, and is less dependant on diet.

In the brush-tailed possum, the Facial Index does not show a regular change with age and there is a great deal of variation between populations (Figures 3, 5). It is therefore not an appropriate measurement to use for the determination of an age scale in this species.

Examination of the total numbers and the distribution of sexes for each wear class and hence age groups in the various populations showed a noticeable difference in the age structure and sex ratio between the populations on the two pastoral properties "Kingston" and "Middle Park" as compared with the populations from the rainforest and sclerophyll forest of Poatina and Maggs Mountain (Figure 6).

There is a greater proportion of animals in molar wear Classes 2 and 3 (age range 1.5 - 4.0 years), subadult and young adult animals from the two pastoral properties, than occurs in the populations from the forested localities where the age distribution is fairly even. The young animals from the more open areas also have an unbalanced sex ratio, biased towards males.

Chi square was used to test the significance of the differences in sex ratio from unity. It was found that there was no significant difference in the total population from any area; however for all molar wear Classes 1-3 from "Kingston" and "Middle Park", there was a significantly higher ($P < 0.05$) proportion of males than expected.

Assuming the population structure in all localities is stable in the short term, then a number of subadult and young adult possums are removed from the pastoral areas either by death or dispersal after, at the most, one breeding season. No such predominance of subadult and young adult possums is found in the animals from the more timbered localities of Maggs Mountain and Poatina.

There are several possible reasons for the observed differences in age structure between the "Kingston" - "Middle Park" and the Poatina - Maggs Mountain populations. A factor which may be significant but which cannot be estimated is the effect that the texture of the food eaten has on rates of molar wear. The forest-dwelling populations of Maggs Mountain and Poatina probably had a similar diet which was quite different from that of the populations from "Kingston" and "Middle Park". This caveat must be remembered in the following discussion.

Changing land use in or adjacent to pastoral areas may be opening up more favourable habitats and encouraging dispersal of young adults into these areas and out of the parent populations. Alternately, there may be a much lower life expectancy in the pastoral areas, perhaps due to human predation, with a high reproductive rate or high survival of juveniles maintaining the populations at their present levels.

The above propositions are based on the assumption that these populations ("Kingston" and "Middle Park") are numerically stable. On the other hand, if they are increasing in

TABLE 1

An analysis of 1,144 brush-tailed possums shot in four localities in the winter of 1979, showing the proportion of sexes in each tooth wear class (age), skulls examined and number shot.

M^1 Wear Class		1	2	3	4	5	6	7	Total Examined		Total Shot	
									#	%	#	%
	♂♂	9	21	29	19	13	9	3	103	60.6	209	58.9
"Kingston"	♀♀	5	16	15	12	12	4	3	67	39.4	142	41.1
Total		14	37	44	31	25	13	6	170	100	355	100
	♂♂	3	23	25	10	3	4	1	69	60.5	215	53.4
"Middle Park"	♀♀	1	8	18	8	8	1	1	45	39.5	184	46.6
Total		4	31	43	18	11	5	2	114	100	399	100
	♂♂	1	7	7	6	6	7	2	36	46.2	160	50.9
Poatina	♀♀	5	7	9	6	10	2	3	42	53.8	154	49.1
Total		6	14	16	12	16	9	5	78	100	314	100
	♂♂	0	2	3	2	2	0	0	9	47.4	40	52.6
Maggs Mt.	♀♀	0	3	3	1	2	0	1	10	52.6	36	47.4
Total		0	5	6	3	4	0	1	19	100	76	100
All localities Total		24	87	109	64	56	27	14	381		1144	

TABLE 2

Mean $\frac{SCL}{SL}$ x 100 (Sagittal Index) for all molar wear classes in each population and in the total population for all skulls measured. Standard deviation is calculated for individuals around the mean of the total population.

Molar Wear Class		1	2	3	4	5	6	7
"Kingston"	♂♂	140.2	173.8	260.3	325.4	370.4	405.9	333.7
	♀♀	137.0	200.7	258.8	269.3	358.8	302.0	369.0
	Both	139.1	185.4	259.8	303.7	364.8	373.9	351.3
"Middle Park"	♂♂	160.7	186.2	274.9	280.3	323.3	386.0	399.0
	♀♀	139.0	181.1	252.1	305.1	306.4	334.0	366.0
	Both	155.3	184.3	265.3	291.3	311.0	375.6	382.5
Poatina	♂♂	135.0	189.7	238.4	279.0	339.7	363.1	361.5
	♀♀	153.0	170.4	262.0	303.8	337.7	325.5	287.0
	Both	150.0	180.1	251.7	291.5	338.5	354.8	316.8
Maggs Mt.	♂♂	—	130.0	323.3	383.5	335.0	—	—
	♀♀	—	190.7	263.0	353.0	344.0	—	389.0
	Both	—	166.4	293.2	373.3	339.5	—	389.0
All localities	♂♂	144.5	179.6	266.6	308.8	353.9	387.0	353.8
	♀♀	144.0	197.1	257.0	290.7	338.2	313.3	340.4
	Both	144.3	186.6	262.6	301.2	344.9	367.9	346.1
Standard Deviation		33.7	26.4	29.5	33.4	35.6	47.5	46.4

numbers, then this may be due to an improvement of habitat encouraging immigration of young animals from surrounding areas. This may also explain the unbalanced sex ratio in these areas as young males are known to be under more pressure to migrate in order to establish a territory than young females (Winter, Ph.D. thesis).

Both a high representation of younger animals and a predominance of males are characteristic of populations with high recruitment rates, i.e. expanding populations, or those with very high rates of adult mortality. These characteristics are not present in the forest-dwelling populations of Maggs Mountain and Poatina and it can be assumed that the populations in these areas are not expanding, nor is there a high level of adult mortality.

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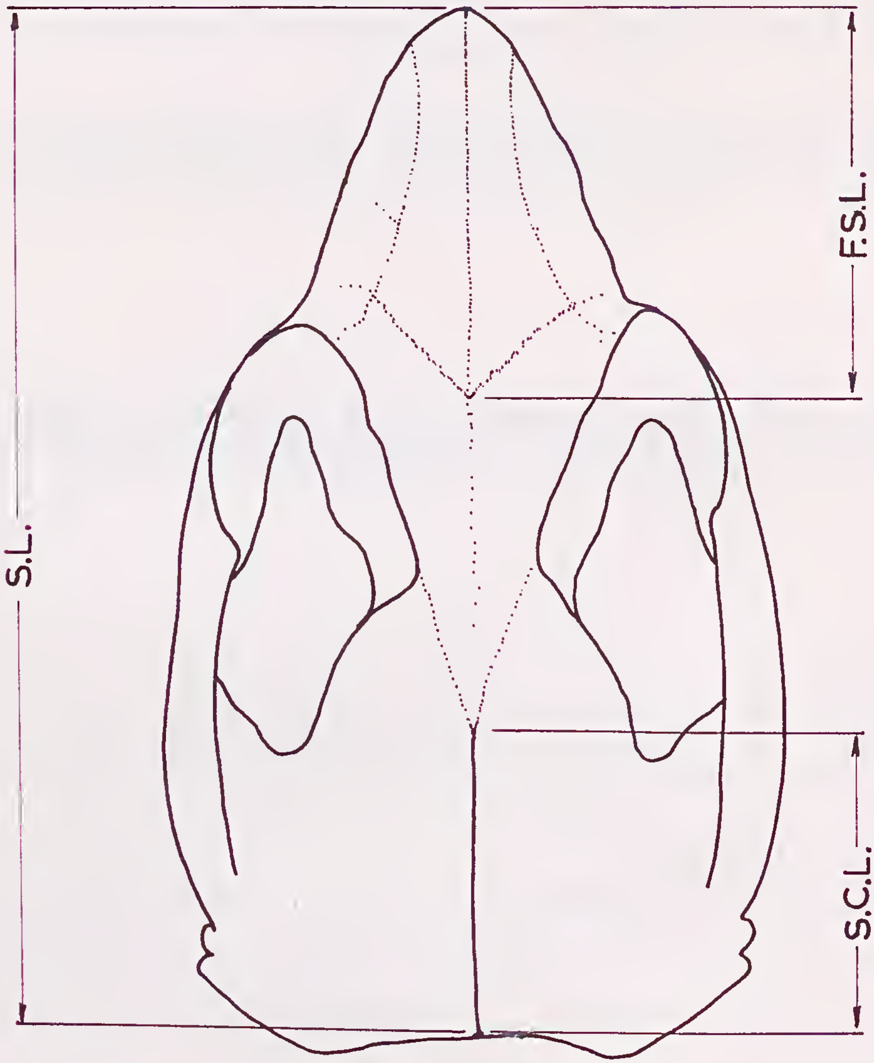

FIGURE 2

Dorsal view of the skull of a brush-tailed possum showing the points from which measurements were taken. Skull length (S.L.), sagittal crest length (S.C.L.), and facial skull length (F.S.L.).

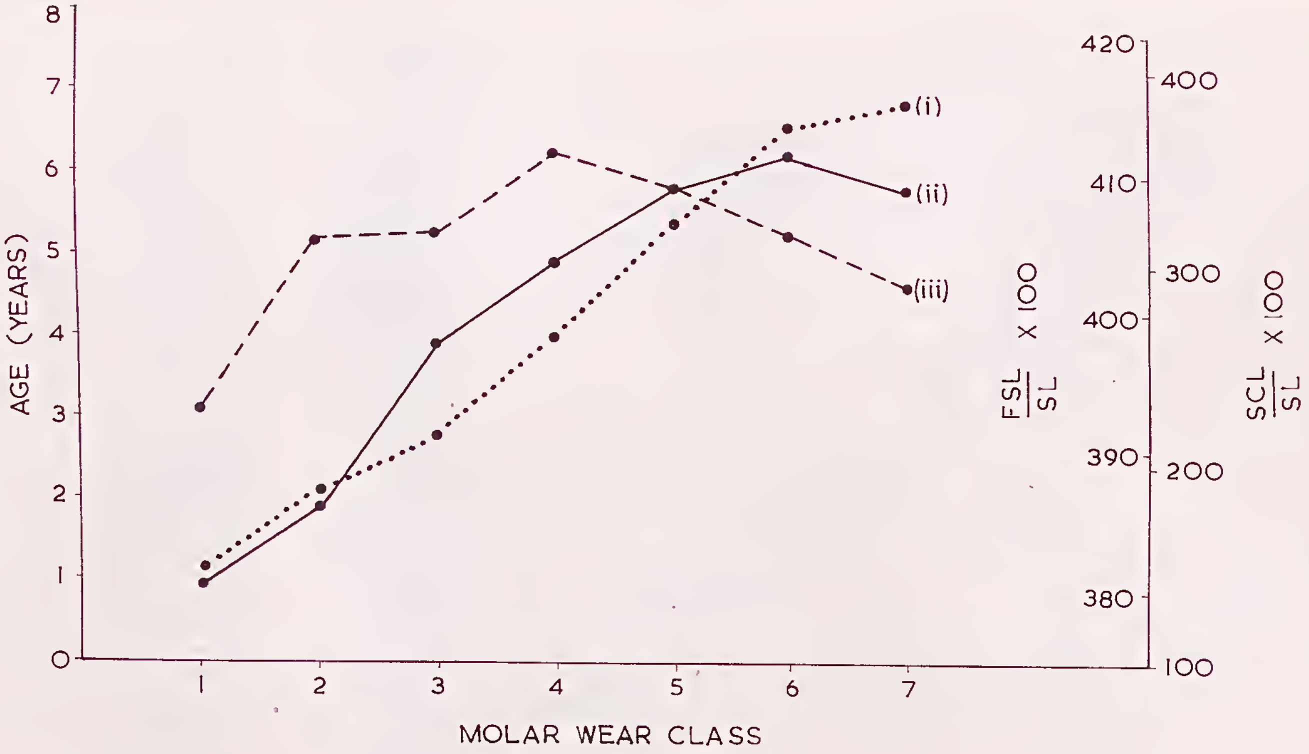

FIGURE 3

(i) Mean age in years (left axis) against molar wear class : data from a sample of known age possums from Queensland (Winter, 1980).

(ii) Means of $\frac{SCL}{SL}$ x 100 (Facial Index) for the same sample.

(iii) Means of $\frac{FSL}{SL}$ x 100 (Sagittal Index) for all Tasmanian skulls sampled.

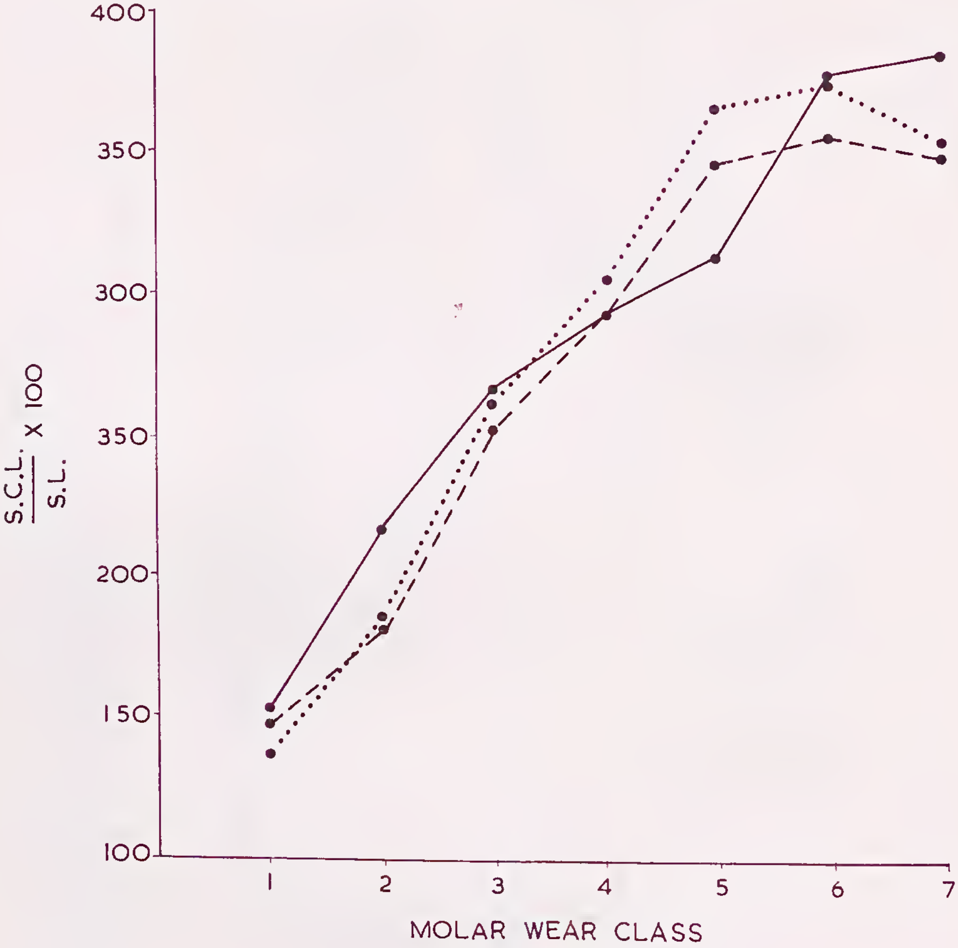

FIGURE 4

Mean values of $\frac{SCL}{SL}$ x 100 (Sagittal Index) for all classes of tooth wear in the "Kingston", "Middle Park" and Poatina populations. Males and females are included together. The Maggs Mountain population was not included because of the small sample size.

•————• "Middle Park", •— — —• Poatina, •··········• "Kingston"

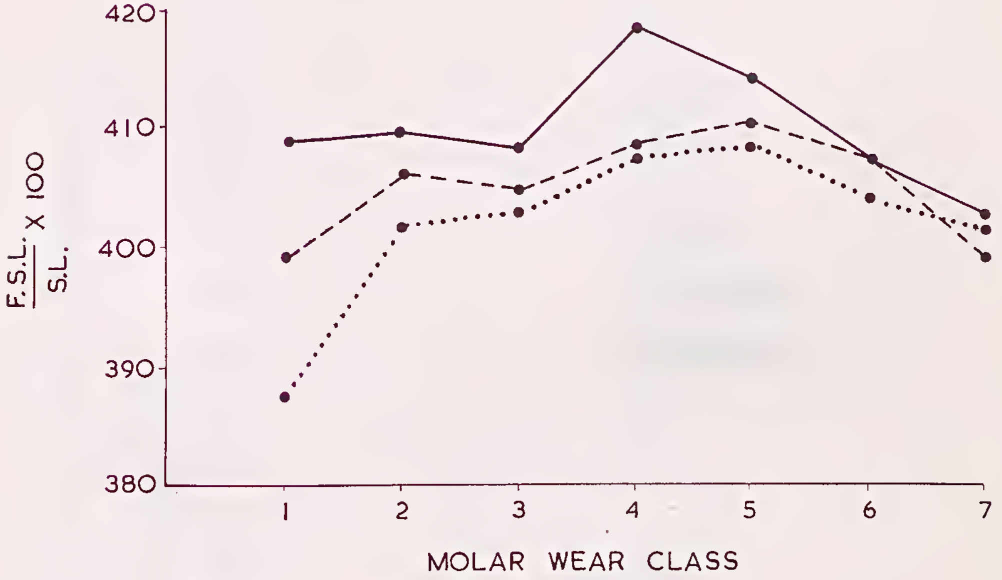

FIGURE 5

Mean values of $\frac{FSL}{SL}$ x 100 (Sagittal Index) for all classes of tooth wear in the "Kingston", "Middle Park" and Poatina populations. Males and females are included together. The Maggs Mountain population was not included because of the small sample size.

•————• "Middle Park", •— — —• Poatina, • • • • • • • • • • ∘ "Kingston"

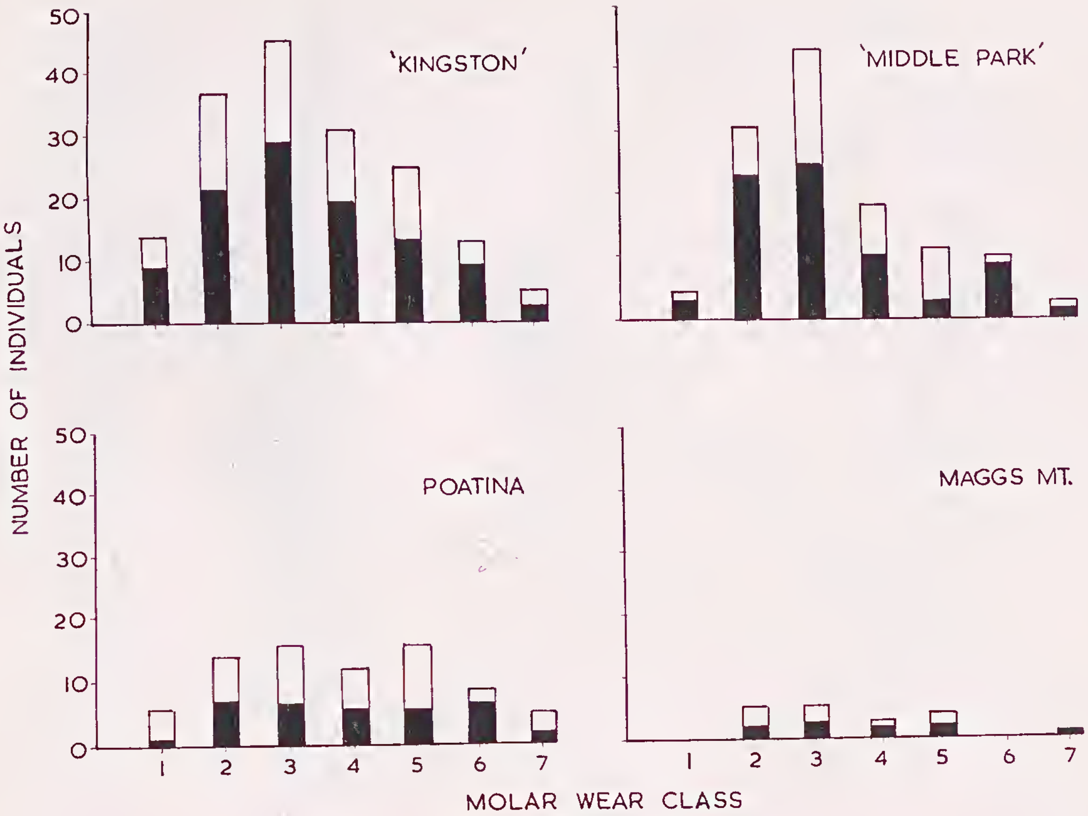

Figure 6

Distribution of individuals in the molar wear classes for each of the populations sampled.

■ = males ☐ = females